IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of
Nigel Cronin

Docket No. 1570.3024.001

Serial No. 09/914,375

Filed: January 15, 2002

For: RADIATION APPLICATOR

MARKED UP COPY OF AMENDMENTS

Box No Fee
Assistant Commissioner for Patents
Washington, D. C. 20231

Sir:

1. An elongate device for insertion into a living body, the device having an antenna [(240,340)] at its tip for coupling radiation into biological matter and a dielectric body [(250,350)] surrounding the antenna so as to encompass substantially the whole of the near-field of the radiation emitted by the antenna.

2. A device as claimed in claim 1 in which the dielectric body [(250,350)] extends from the antenna [(240,340)] a distance determined in accordance with the wavelength of said radiation in the dielectric.

3. A device as claimed in claim 1 [or 2] in which the dielectric body [(250,350)] extends from the antenna a distance determined in accordance with the major dimension (L) of the antenna [(240,340)] in the dielectric.

4. A device as claimed in [any one of the preceding claims] claim 1 in which the dielectric body [(250,350)] extends from the antenna [(240,340)] a distance at

least substantially equal to $2L^2/\lambda$, where L is the major dimension of the antenna and λ is the wavelength of the radiation in the dielectric.

5. A device as claimed in [any one of the preceding claims] claim 1 in which the dielectric body [(250,350)] comprises a substantially cylindrical portion with the antenna [(240,340)] extending axially at its centre a distance L.

6. A device as claimed in [any of] claim[s] 2 [to 5] in which the dielectric body [(250,350)] extends from the antenna [(240,340)] a distance substantially equal to half the wavelength of said radiation in the dielectric.

7. A device as claimed in [any one of the preceding claims] claim 1 in which the dielectric body [(350)] is such that it has a dielectric constant at its core [(360)] which is higher than the dielectric constant at its outer periphery [(380)], the latter being more closely matched to that of said living tissue.

8. A device as claimed in claim 7 in which the dielectric body [(350)] comprises an inner core [(360)] and an outer layer [(380)], each of a different dielectric constant.

9. A device as claimed in claim 8 in which the inner core [(360)] and outer layer [(380)] have those dimensions that extend from the antenna [(340)] determined in accordance with the dielectric constant of each so that the overall dimension is a predetermined fraction of the nominal wavelength of the radiation in the dielectric.

10. A device as claimed in claim 9 in which the inner core [(360)] and outer layer [(380)] each have a dimension substantially equal to a quarter of the wavelength of radiation therein.

11. A device as claimed in [any of] claim[s] 8 [to 10] in which the outer layer [(380)] is formed with indentations in its outer surface which serve to reduce the dielectric constant in this region when the indentations are filled with other matter.

12. A device as claimed in claim 7 in which the dielectric constant of the dielectric body [(350)] varies continuously over at least a part of the distance from the antenna [(340)].

13. A device as claimed in [any one of the preceding claims] claim 1 which has a tip portion [(270,370)] that extends beyond the end of the antenna.

14. A device as claimed in claim 13 in which the tip portion [(370)] is pointed to assist penetration of biological matter.

15. A device as claimed in claim 14 in which the tip portion [(370)] is composed of a different material to the dielectric body [(340)].

16. A device as claimed in claim 13 in which the tip portion [(270)] is an extension of the dielectric body [(250)] and is rounded so as to support forward transmission of radiation.

17. A device as claimed in claim 16 in which the tip portion [(270)] is substantially hemispherical.

18. A device as claimed in claim 17 in which the tip portion [(270)] has a radius substantially equal to half the wavelength of the radiation in the dielectric [(250)].

19. A device as claimed in [any one of the preceding claims] claim 1 in which the elongate device comprises a coaxial conductor [(120,320)] with a central conductor [(220,240)] that projects beyond outer screening of the coaxial conductor at the distal end to form the antenna [(240,340)].

20. A device as claimed in claim 19 in which the antenna [(240,340)] has a length substantially equal to half the wavelength of the radiation in the dielectric.

21. A device as claimed in claim[s] 19 [or 20] including a transformer [(310)] between the coaxial conductor [(120,320)] and the dielectric body [(250,350)] to reduce reflection of radiation back into the coaxial conductor at the boundary with the dielectric body.

22. A device as claimed in claim 21 in which the transformer [(310)] includes a space within the coaxial conductor into which packing of the coaxial conductor can expand.

23. An elongate device for insertion into a living body, the device having antenna [(240)] at its tip for coupling radiation into biological matter and a dielectric body [(340)] surrounding the antenna [(240)] so as to enhance transmission of radiation in the forward direction.

24. A device as claimed in claim 23 in which the dielectric body [(250)] has a rounded tip portion [(270)] that extends beyond the end of the antenna [(240)] to support forward transmission of radiation reflected internally from the outer surface of the dielectric body.

25. A device as claimed in claim 24 in which the tip portion [(270)] is substantially hemispherical.

26. A device as claimed in claim 25 in which the tip portion [(270)] has a radius substantially equal to half the wavelength of the radiation in the dielectric.

27. A device as claimed in [any one of] claim[s] 23 [to 26] in which the antenna [(240)] extends a distance substantially equal to half the wavelength of said radiation in the dielectric.

28. A device as claimed in [any one of] claim[s] 23 [to 27] in which the dielectric body [(250)] comprises a substantially cylindrical portion with the antenna means [(240)] extending axially at its centre.

29. A device as claimed in [any one of] claim[s] 23 [to 28] in which the dielectric body [(250)] extends from the antenna [(240)] a distance substantially equal to half a wavelength of the radiation in the dielectric body.

30. A method of coupling radiation into biological material, the radiation being generated by an applicator comprising an antenna [(240,340)] surrounded by a dielectric body [(250,350)], comprising the steps of selecting the dielectric constant of the body [(250,350)] in accordance with the wavelength of the radiation in the dielectric so that substantially the whole of the near-field of the radiation is encompassed by the dielectric body [(250,350)].

31. A method as claimed in claim 30 in which the dielectric constant of the body [(250,350)] is further selected in accordance with the major dimension of the antenna [(240,340)].

32. A method as claimed in claim 30 [or claim 31] in which the dielectric body [(250,350)] extends from the antenna a distance at least substantially equal to $2L^2/\lambda$, where L is the major dimension of the antenna and λ is the wavelength of the radiation in the dielectric.

33. A method as claimed in [any one of] claim[s] 30 [to 32] in which the major dimension of the antenna [(240,340)] is its length, which is substantially equal to half a wavelength of the radiation in the dielectric.

34. A method as claimed in [any one of] claim[s] 30 [to 33] in which the dielectric body [(250,350)] is located in relation to the biological material so that the far-field radiation lies within the biological material.

35. A method as claimed in [any one of] claim[s] 30 [to 34] in which the dielectric constant of the body [(250,350)] is high, but is lower than that of the biological material.

36. A method as claimed in [any one of] claim[s] 30 [to 34] in which the dielectric constant of the dielectric body [(350)] varies, and is higher at its core [(360)] than its outer periphery [(380)], and the dielectric constant at its outer periphery is lower than that of the surrounding biological matter.

37. A method as claimed in claim 35 in which the dielectric constant at the core [(360)] is greater than the dielectric constant of the biological matter.

38. A method of coupling radiation into biological material, the radiation being generated by an elongate applicator comprising an antenna [(240)] surrounded by a dielectric body [(250)], the dielectric body being configured so as to enhance transmission of the radiation in the forward direction along the elongate axis of the applicator.

39. A method as claimed in claim 38 in which radiation is partially reflected internally of the dielectric body [(250)] so as to be transmitted in the forward direction.

40. A method as claimed in claim 39 in which the dielectric constant of the body [(250)] is high but is lower than that of the biological material.

41. A method as claimed in [any one of] claim[s] 38 [to 40] in which the dielectric body [(250)] has a substantially hemispherical tip portion [(270)] with a radius substantially equal to half the wavelength of the radiation in the dielectric.

42. A method as claimed in [any one of] claim[s] 38 [to 41] in which the antenna [(240)] has a length substantially equal to half the wavelength of the radiation in the dielectric.

43. A method as claimed in [any one of] claim[s] 38 [to 42] in which the dielectric body [(250)] extends from the antenna [(240)] a distance substantially equal to half the wavelength of the radiation in the dielectric.

Respectfully submitted,

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